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Original Article

Comparison of Pulmonary Embolism and Subsequent Cardiovascular Events Between Elderly and Young Patients in the Emergency Department☆

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SUMMARY

Background: Pulmonary embolism (PE) has been associated with the risk of arterial cardiovascular events, with diagnosis being difficult in older adults. Multiple factors contribute to mortality and morbidity in older adults. Hence, we aimed to investigate the difference of subsequent cardiovascular events (SCVE) and demography between younger and older adults.

Methods: We undertook a retrospective cohort study using data from a 1100-bed urban medical center in Taipei, Taiwan. All patients who presented to the emergency department with a documented diagnosis of PE (ICD-9 of 415.19), from January 2003 to December 2008, were enrolled and specified into two age groups. Clinical follow-up was conducted until December 2009, with a median time of 3.5 years. The SCVE included new onset of ischemic stroke or heart attack and recurrence of PE. The time between when a patient was presented to the ER and when the diagnosis took place was assessed.

Results: A total of 104 patients were studied, among which 58 patients were placed in the elderly group ($\geq$ 65 years old) and 46 were placed in the young group ($<$ 65 years old). There were significantly more females in the elderly group ($n = 43$; 74.1%; $p < 0.05$). Underlying morbidities including diabetes mellitus (DM), chronic renal failure, hypertension, ischemic stroke, ischemic heart disease, and heart failure were significantly more predominant in the elderly group. There was no significant difference between the two groups in terms of clinical presentation and the incidence of massive PE. A total of 9 patients (8.7%) expired during their hospital stay, with no difference between the two groups. SCVE showed only a significant difference among new ischemic heart disease ($n = 6$; 10.3%). There was a significant difference in diagnosis intervals between the two groups (elderly $= 48.5 \pm 83.9$ hours; young $= 21.4 \pm 38.5$ hours; < 0.05).

Conclusion: Diagnosis intervals in the elderly were widely variable. Rapid and precise diagnosis of PE in the emergency department remains a challenge. Clinical presentations gave less useful information to make a correct diagnosis of PE, especially in the elderly. There are more new episodes of ischemic heart disease in the elderly followed by PE, but no significant difference in the overall SCVE between the two groups. The relationship between SCVE and age in patients with PE may need further evaluation.

1. Introduction

Elderly patients with pulmonary embolism (PE) are at high risk for morbidity and mortality because of the difficulty in diagnosis and treatment[1]. Multiple factors contribute to mortality and morbidity in older adults. Currently, the available information on the long-term clinical course of patients with PE is essentially derived from a study which concluded that cancer, congestive heart failure, and chronic lung disease are the risk factors of dying within 1 year[2]. Arterial thrombosis and venous thrombosis were categorized as separate diseases in terms of pathogenesis and risk factors. In recent years, arterial cardiovascular events, such as myocardial infarction and stroke, have been added as important prognostic factors for evaluating the clinical outcome of acute PE[3–5]. In another study, the incidence of myocardial infarction was more than twice as common and stroke was almost three times as common in the 1st year following an episode of PE[6]. Despite advances in the management of pulmonary embolism, little contemporary data describes or compares the influence of age on predisposing factors, diagnostic tests, or clinical presentation of PE[7].

☆ All contributing authors declare no conflict of interest.

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We were also interested in the influence of age on the prognosis of PE. We aimed to investigate the difference in subsequent cardiovascular events (SCVE) between younger and older adults.

2. Methods

We undertook a retrospective cohort study, using data from a 1100-bed urban medical center in Taipei, Taiwan. Patients, with an objectively documented episode of PE (ICD-9 of 415.19), were enrolled into this study if they were > 18 years old and presented to the emergency department between January 2003 and December 2008. The patients were divided into two groups based on age; in one group, patients were < 65 years old and in the other, patients were ≥ 65 years old. Objective diagnosis of PE included a high-probability ventilation/perfusion lung scintigraphy, an abnormal pulmonary angiography, or an abnormal spiral computed tomography of the chest[8]. All medical records were reviewed by two physicians regarding the presenting symptoms, clinical courses, the laboratory results, and other diagnostic tests. Clinical follow-up took place until December 2009, with a median time of 3.5 years. Information about co-morbidity that may have added risks to the development of PE were recorded, including diabetes mellitus (DM), hypertension, cerebrovascular disease, cardiovascular disease, uremia, congestive heart failure (CHF), history of coronary artery disease (CAD), and history of deep venous thrombosis (DVT)[9]. Certain factors influencing PE, such as the presence of prolonged immobilization, smoking, malignancies on active parenteral chemotherapy, recent major procedures on vascular interventions, and recent trauma, were also obtained through medical record reviews[10].

Study design and definition: Prolonged immobilization was defined as being immobilized for > 1 week. Recent trauma was defined as an accident that occurred < 3 months ago. Recent major vascular intervention indicated the need for insertion of a central venous line or port-A within 2 weeks before presentation. For the severity of disease, massive PE indicates systemic hypotension or cardiogenic shock. Systemic hypotension is defined as a systolic arterial pressure < 90 mmHg or a drop in systolic arterial pressure of ≥ 40 mmHg for at least 15 minutes[11]. SCVE included new onset of ischemic stroke, acute myocardial infarction, and recurrence of PE[12]. Acute myocardial infarction was defined as the presence of two of the following criteria: (1) typical ischemic chest pain of acute onset; (2) elevation of troponin or creatinine kinase enzyme and its MB fraction ≥ 5%; and (3) ECG changes including new, dynamic ST/T changes in at least two consecutive leads. Ischemic stroke was defined as the presence of a new focal neurological deficit, confirmed by a CT scan or magnetic resonance image, lasting more than 24 hours[12]. Recurrent PE was defined by having one of the following criteria: (1) a new filling defect in a spiral CT or pulmonary angiography; or (2) a new high probability perfusion defect in a ventilation/perfusion lung scan[8]. We also assessed the duration between emergency department (ED) presentation and the time when a diagnosis of PE was made. Statistical analysis was conducted by using SPSS software version 12.0 (SPSS Inc., Chicago IL., USA). The Chi-square and Fisher's exact tests were performed for categorical variables. We used independent-samples *t* tests for continuous variables. A *p* value of < 0.05 was the criterion for statistical significance.

3. Results

Between January 2003 and December 2008, we reviewed a total of 104 consecutive patients diagnosed with PE, among which 58 patients were placed in the elderly group (≥ 65 years old) and 46 were placed in the young group (< 65 years old). Females were the predominant sex in the elderly group ($n = 43$; 74.1%; $p < 0.05$). Underlying morbidity including DM, uremia, hypertension, ischemic stroke, coronary artery disease, and congestive heart failure were all significantly predominant in the elderly group ($p < 0.05$). There was no significant difference between the two groups with regards to the clinical presenting symptoms; the two main complaints for seeking medical help were shortness of breath and chest pain (Table 1).

Table 1
Demographic, co-morbidity, and symptoms for the two age groups.

	Age ≧ 65 y ($n = 58$)	Age < 65 y ($n = 46$)
Age, y ± SD	77 ± 8	47 ± 12
	n (%)	*n* (%)
Demographic and medical comorbidity		
Sex (male)*	15 (25.9)	21(45.7)
Immobilization	18 (31)	8 (17.4)
Recent trauma	4 (6.9)	1 (2.2)
DM*	20 (34.5)	5(10.9)
Uremia*	8 (13.8)	0 (0)
Smoking	17 (29.3)	13 (28.3)
Hypertension*	44 (75.9)	19 (41.3)
Hx of stroke*	12 (20.7)	3 (6.5)
Hx of CAD*	18 (31)	5 (10.9)
Hx of DVT	5 (8.6)	3 (6.5)
CHF*	21 (36.2)	6 (13)
Active heparin use	6 (10.3)	2 (4.3)
Active chemotherapy	4 (6.9)	2 (4.3)
Recent procedural for central venous line	2 (3.4)	3 (6.5)
Symptoms		
Hemoptysis	0 (0)	2 (4.3)
Short of breath	49 (84.5)	42 (91.3)
Chest pain	27 (46.6)	24 (52.2)
Fever	10 (17.2)	9 (19.6)
Cough	19 (32.8)	11 (23.9)
Shock	10 (17.2)	13 (28.3)
Syncope	11 (19)	13 (28.3)
Limb edema	20 (34.5)	16 (34.8)
Limb pain	13 (22.4)	11 (23.9)

DM = diabetes mellitus; CAD = coronary artery disease; DVT = deep venous thrombosis; CHF = congestive heart failure.
*Significantly different, $p < 0.05$.

The diagnostic interval, severity of pulmonary embolism, and prognosis were compared between the two groups (Table 2). There was a significant difference between the two groups with regards to the average time from when they arrived at the emergency department to the time their diagnosis was made (average time = 48.5 ± 83.9 hours in the elderly group; average time = 21.4 ± 38.5 hours in the young group; $p < 0.05$). Furthermore,

Table 2
Diagnostic interval, severity, and prognosis for the two age groups.

	Age ≥ 65 y ($n = 58$)	Age < 65 y ($n = 46$)
	n (%)	*n* (%)
Diagnostic interval*, h ± SD	48.5 ± 83.9	21.4 ± 38.5
Diagnosis made after 24 h ($p = 0.053$)	22 (37.9)	9 (19.6)
Severity		
Massive PE ($p = 0.105$)	10 (17.2)	15 (32.6)
Prognosis		
In-hospital mortality ($p = 0.728$)	6 (10.3)	3 (6.5)
New stroke ($p = 0.103$)	6 (10.3)	1 (2.2)
New AMI*	6 (10.3)	0 (0)
Recurrent PE ($p = 0.237$)	2 (3.4)	5 (10.9)
Cardiovascular events ($p = 0.207$)	13 (22.4)	6 (13)

ED = emergency department; PE = pulmonary embolism; AMI = acute myocardial infarction.
Massive pulmonary embolism is defined by systemic hypotension or cardiogenic shock.
*Significantly different, $p < 0.05$.

this timely trend demonstrated that the rate of late-diagnosis after 24 hours of presentation was higher in elderly patients (37.9%) as compared to that of young patients (19.6%); $p = 0.053$. However, with regards to the incidence of massive PE, there was no significant difference between two groups [elderly = 10 patients (17.2%); young = 15 patients (32.6%); $p = 0.105$]. With regards to the prognosis, 9 patients (8.7%) died during the stay in hospital and there was no difference between the two groups [elderly = 6 patients (10.3%); young = 3 patients (6.5%); $p = 0.728$]. However, the SCVE showed a significant difference with regards to new acute myocardial infarction in the elderly group (6 patients, 10.3%, $p < 0.05$).

4. Discussion

PE is the blockage of the main artery of one or both lungs; however, the severity and duration of symptoms can vary greatly, which makes PE diagnosis difficult[1,13]. We attempted to determine the different manifestations between elderly and young patients in our study. Moreover, the main objective of this study was to compare the prognosis of PE in patients of different age groups, regarding the incidence of major unfavorable outcomes during short and long-term follow-up, especially for subsequent cardiovascular events. Our report showed 3 and 6 mortality cases among elderly and young patients, respectively. There was no difference between these two groups in short-term mortality or severity of PE. However, according to the results of our study, elderly patients had a higher risk of subsequent acute myocardial infarction after acute PE when compared to young patients in long-term follow-up. This phenomenon has been described by Sorensen et al[6] There is an association between atherosclerotic disease and spontaneous venous thrombosis, and this association is stronger in elderly patients[14]. However, another study demonstrated that the incidence of arterial cardiovascular events for all patients with PE did not increase compared to patients without PE[5]. For this reason, the relationship between SCVE after an episode of PE may need more evaluation. Nevertheless, the findings in our study provide useful information between young and elderly patients regarding the mortality profile and the risk for SCVE in cases with PE.

Another main objective of our study was to analyze the diagnostic interval and the initial clinical presenting symptoms. One study showed that in symptomatic outpatients being considered for possible PE, non-cancer-related thrombophilia, pleuritic chest pain, and family history of venous thromboembolism, increase the probability of PE or deep venous thrombosis[15]. However, in our study, there was no clinical presentation that showed a specific clue in elderly patients with PE.

5. Conclusion

Although the risk of subsequent myocardial infarction after acute PE in the elderly is higher, there was no significant difference noted in the overall SCVE between two groups in our study. However, a limitation of our study is that the follow-up period was not optimal. More long-term follow-up after PE may be needed for more thorough research. The relationship between PE and SCVE may also need further evaluation. Furthermore, our study showed that diagnosis intervals in the elderly were more widely variable, and the rate of late-diagnosis after 24 hours of presentation had a higher timely trend in elderly patients when compared with younger patients. Rapid and precise diagnosis of PE in the emergency department remains a challenge for emergency physicians, and the early diagnosis of PE is more difficult in the elderly.

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